IMPROVED NON-PYROPHORIC WATER-GAS SHIFT REACTION CATALYSTS

This application is a continuation-in-part of US Serial No. 09/669,044, filed September 25, 2000, abandoned the disclosure of which is herein incorporated by reference as if fully set forth herein.

The present invention relates to low-pyrophoricity water-gas shift catalysts having a strong structural support and methods of their use for generating hydrogen by reaction of carbon monoxide (CO) and water (H_2O) in fluid media, and in particular to generating hydrogen in a gas stream comprising hydrogen, water, and carbon monoxide. The catalysts and methods of the invention are useful, for example, in generating hydrogen in the gas stream supplied to a fuel cell, particularly to proton exchange membrane (PEM) fuel cells.

Fuel cells directly convert chemical energy into electricity thereby eliminating the mechanical process steps that limit thermodynamic efficiency, and have been proposed as a power source for many applications. The fuel cell can be 2 to 3 times as efficient as the internal combustion engine with little, if any, emission of primary pollutants such as carbon monoxide, hydrocarbons and nitric oxides. Fuel cell-powered vehicles which reform hydrocarbons to power the fuel cell generate less carbon dioxide (green house gas) and have enhanced fuel efficiency.

Fuel cells, including PEM fuel cells [also called solid polymer electrolyte or (SPE) fuel cells], as known in the art, generate electrical power in a chemical reaction between a reducing agent (hydrogen) and an oxidizing agent (oxygen) which are fed to the fuel cells. A PEM fuel cell comprises an anode and a cathode separated by a membrane which is usually an ion exchange resin membrane. The anode and cathode electrodes are typically constructed from finely divided carbon particles and proton conductive resin intermingled with the catalytic and carbon particles. In typical PEM fuel cell operation, hydrogen gas is electrolytically oxidized to hydrogen ions at the anode composed of platinum reaction catalysts deposited on a conductive carbon electrode. The protons pass through the ion exchange resin membrane, which can be a fluoropolymer of sulfonic acid called a proton exchange membrane. H_2O is produced when protons then combine with oxygen that has been electrolytically reduced at the cathode. The electrons flow through an external circuit in this process to do work, for